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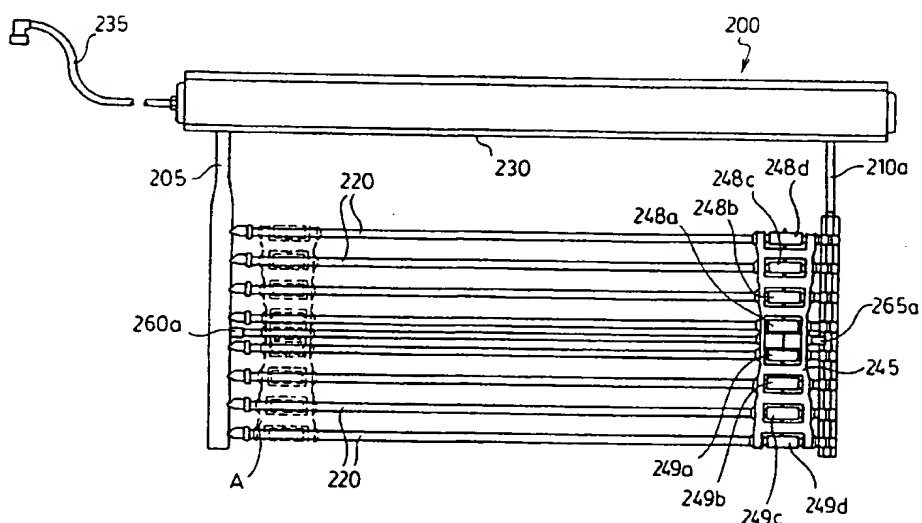
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(54) Title: RADIATION SOURCE MODULE AND CLEANING APPARATUS THEREFOR



(57) Abstract

A cleaning apparatus for a radiation source assembly (220) in a fluid treatment system is described. The cleaning apparatus comprises: a carriage (245) movable with respect to an exterior of the radiation source assembly (220); at least one cleaning sleeve (248, 249) in sliding engagement with the exterior of the radiation source assembly, the at least one cleaning sleeve being moveable with respect to the carriage; and drive means coupled to the carriage to translate the carriage whereby the at least one cleaning sleeve is translated over the exterior of the radiation source assembly. A radiation source module (200) comprising the cleaning apparatus is also disclosed. The radiation source module is particularly useful for ultraviolet radiation of wastewater while having the advantages of *in situ* cleaning of the radiation source when it becomes fouled. Radiation source replacement is also facilitated.

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RADIATION SOURCE MODULE AND CLEANING
APPARATUS THEREFOR

TECHNICAL FIELD

5 In one of its aspects, the present invention relates to a cleaning apparatus for use in a fluid treatment module. In another of its aspects, the present invention relates to a radiation source module comprising the cleaning apparatus.

BACKGROUND ART

10 Fluid treatment systems are known generally in the art.

 For example, United States patents 4,482,809, 4,872,980 and 5,006,244 (all in the name of Maarschalkerweerd and all assigned to the assignee of the present invention and hereinafter referred to as the Maarschalkerweerd #1 Patents), the contents of each of which are hereby incorporated by reference, all
15 describe gravity fed fluid treatment systems which employ ultraviolet (UV) radiation.

 Such systems include an array of UV lamp frames which include several UV lamps each of which are mounted within sleeves which extend between and are supported by a pair of legs which are attached to a cross-piece. The so-
20 supported sleeves (containing the UV lamps) are immersed into a fluid to be treated which is then irradiated as required. The amount of radiation to which the fluid is exposed is determined by the proximity of the fluid to the lamps, the output wattage of the lamps and the fluid's flow rate past the lamps. Typically, one or more UV sensors may be employed to monitor the UV output of the lamps
25 and the fluid level is typically controlled, to some extent, downstream of the treatment device by means of level gates or the like.

 However, disadvantages exist with the above-described systems. Depending upon the quality of the fluid which is being treated, the sleeves surrounding the UV lamps periodically become fouled with foreign materials,
30 inhibiting their ability to transmit UV radiation to the fluid. For a given installation, the occurrence of such fouling may be determined from historical operating data or by measurements from the UV sensors. Once fouling has

reached a certain point, the sleeves must be cleaned to remove the fouling materials and optimize system performance.

If the UV lamp modules are employed in an open, channel-like system (e.g., such as the one described and illustrated in Maarschalkerweerd #1 Patents), one or more of the modules may be removed while the system continues to operate, and the removed frames may be immersed in a bath of suitable cleaning solution (e.g., a mild acid) which may be air-agitated to remove fouling materials. Of course, this necessitates the provision of surplus or redundant sources of UV radiation (usually by including extra UV lamp modules) to ensure adequate irradiation of the fluid being treated while one or more of the frames has been removed for cleaning. This required surplus UV capacity adds to the capital expense of installing the treatment system. Further, a cleaning vessel for receiving the UV lamp modules must also be provided and maintained. Depending on the number of modules which must be serviced for cleaning at one time and the frequency at which they require cleaning, this can also significantly add to the expense of operating and maintaining the treatment system. Furthermore, this cleaning regimen necessitates relatively high labor costs to attend to the required removal/re-installation of modules and removal/re-filling of cleaning solution in the cleaning vessel. Still further, such handling of the modules results in an increased risk of damage to or breakage of the lamps in the module.

If the frames are in a closed system (e.g., such as the treatment chamber described in United States patent 5,504,335 (in the name of Maarschalkerweerd and assigned to the assignee of the present invention), the contents of which are hereby incorporated by reference), removal of the frames from the fluid for cleaning is usually impractical. In this case, the sleeves must be cleaned by suspending treatment of the fluid, shutting inlet and outlet valves to the treatment enclosure and filling the entire treatment enclosure with the cleaning solution and air-agitating the fluid to remove the fouling materials. Cleaning such closed systems suffers from the disadvantages that the treatment system must be stopped while cleaning proceeds and that a large quantity of cleaning solution must be employed to fill the treatment enclosure. An additional problem exists in that

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handling large quantities of cleaning fluid is hazardous and disposing of large quantities of used cleaning fluid is difficult and/or expensive. Of course open flow systems suffer from these two problems, albeit to a lesser degree.

Indeed, it is the belief of the present inventors that, once installed, one of the largest maintenance costs associated with prior art fluid treatment systems is often the cost of cleaning the sleeves about the radiation sources.

United States patents 5,418,370, 5,539,210 and 5,590,390 (all in the name of Maarschalkerweerd and all assigned to the assignee of the present invention and hereinafter referred to as the Maarschalkerweerd #2 Patents), the contents of each of which are hereby incorporated by reference, all describe an improved cleaning system, particularly advantageous for use in gravity fed fluid treatment systems which employ UV radiation. Generally, the cleaning system comprises a cleaning sleeve engaging a portion of the exterior of a radiation source assembly including a radiation source (e.g., a UV lamp). The cleaning sleeve is movable between: (i) a retracted position wherein a first portion of radiation source assembly is exposed to a flow of fluid to be treated, and (ii) an extended position wherein the first portion of the radiation source assembly is completely or partially covered by the cleaning sleeve. The cleaning sleeve includes a chamber in contact with the first portion of the radiation source assembly. The chamber is supplied with a cleaning solution suitable for removing undesired materials from the first portion of the radiation source assembly.

The cleaning system described in the Maarschalkerweerd #2 Patents represents a significant advance in the art, especially when implemented in the radiation source module and fluid treatment system illustrated in these patents. However, implementation of the illustrated cleaning system in a fluid treatment module such as the one illustrated in the Maarschalkerweerd #1 Patents is problematic.

The reason for this is that the specific system illustrated in the Maarschalkerweerd #2 Patents is based a conventional rod/cylinder design (see especially Figure 6 and the accompanying text in the Maarschalkerweerd #2 Patents). Specifically, the cleaning rings (308) are connected to a rod (328) disposed in a cylinder (312,314). In use the rod (328) is extended from or

retracted into the cylinder (312,314).
the quartz sleeve surrounding the ultraviolet lamp. Thus, when the rod (328) is
extended to its extreme stroke end from the cylinder (312,314), the overall length
of the rod and the cylinder is approximately twice as long as the rod stroke.

5 While this approach dovetails nicely with the radiation source module and fluid
treatment system illustrated in the Maarschalkerweerd #2 Patents, it is difficult
to implement the fluid treatment module illustrated in the Maarschalkerweerd #1
Patents since, in the latter Patents, the lamp is supported at both ends by an
opposed pair of legs. In such a case, the distance between the opposed pair of
10 legs would have to be doubled to allow for provision of a conventional
rod/cylinder design where a single wiper is used. This becomes impractical since
a preferred embodiment of the module illustrated in the Maarschalkerweerd #1
Patents involves using a low pressure, ultraviolet radiation lamp which can be up
to be about five feet in length to provide the necessary wattage of radiation. This
15 mitigates against doubling the distance between the pair of opposed legs used to
support the lamps.

In United States patent application S.N. 09/185,813 [Pearcey et al.
(Pearcey)], filed November 3, 1998 and the contents of which are hereby
incorporated by reference, there is disclosed a cleaning apparatus for a radiation
20 source module and a radiation source module incorporated such cleaning
apparatus. Generally, the cleaning apparatus and related module comprise: (i) a
slidable member magnetically coupled to a cleaning sleeve, the slidable member
being disposed on and slidable with respect to a rodless cylinder; and (ii) motive
means to translate the slidable member along the rodless cylinder whereby the
25 cleaning sleeve is translated over the exterior of the radiation source assembly.
The teachings of Pearcey represent a significant advance in the art, particularly
when implemented in a fluid treatment module such as the one illustrated in
Maarschalkerweerd #1 Patents.

Notwithstanding this, there remains a need in the art for a cleaning
30 apparatus which obviates or mitigates at least one of the above-mentioned
disadvantages of the prior art. It would be desirable to have such a cleaning
apparatus which is particularly well suited for implementation on a fluid

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treatment module such as the one illustrated in the Maarschalkerweerd #1 Patents. More specifically, it would be beneficial to have a cleaning apparatus which facilitates radiation lamp replacement and which does not place undue forces on the radiation source assemblies cleaned thereby.

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DISCLOSURE OF THE INVENTION

It is an object of the invention to provide a cleaning system which obviates or mitigates at least one of the above-mentioned disadvantages of the prior art.

10 Accordingly, in one of its aspects, the present invention provides a cleaning apparatus for a radiation source assembly in a fluid treatment system, the cleaning system comprising:

a carriage movable with respect to an exterior of the radiation source assembly;

15 at least one cleaning sleeve in sliding engagement with the exterior of the radiation source assembly, the at least one cleaning sleeve being moveable with respect to the carriage; and

drive means coupled to the carriage to translate the carriage whereby the at least one cleaning sleeve is translated over the exterior of the radiation source
20 assembly.

In another of its aspects, the present invention provides radiation source module for use in a fluid treatment system, the module comprising:

a frame having a first support member;

25 at least one radiation source assembly extending from and in sealing engagement with the first support member, the at least one radiation source assembly comprising a radiation source;

cleaning means to remove undesired materials from an exterior of the at least one radiation source assembly, the cleaning means comprising:

30 a carriage movable with respect to an exterior of the radiation source assembly;

at least one cleaning sleeve in sliding engagement with the exterior of the radiation source assembly, the at least one cleaning sleeve being moveable with respect to the carriage; and

drive means coupled to the carriage to translate the carriage whereby the
5 at least one cleaning sleeve is translated over the exterior of the radiation source assembly.

Thus, the present inventors have developed an improved cleaning apparatus useful in a radiation source module. Generally, the present cleaning apparatus comprises a cleaning sleeve which is movable with respect to the
10 carriage that is driven to actuate the cleaning step. In a sense, the cleaning sleeve may be regarded as a "floating" cleaning sleeve movable with respect to the carriage (this will be discussed in more detail hereinbelow). An advantage of such an arrangement is particularly noted when the cleaning apparatus is used in a radiation source module having more than one radiation source assembly (e.g.,
15 each assembly may be regarded as a combination of a radiation lamp and a protective quartz sleeve). In this arrangement of the present cleaning apparatus, since the cleaning sleeves for each radiation source assembly are moveable independent of the carriage and of one another, there is a reduction in the lateral forces to which the radiation source assemblies are subjected. This minimizes
20 breakage of the radiation source assemblies and reduces the lateral forces created on the radiation source assemblies and the minimum applied force required to actuate the cleaning apparatus. The result of this is to reduce the overall cost of constructing the cleaning apparatus in combination with a reduction in the cost to operate the apparatus (i.e., reduced energy costs). Further, this allows for a
25 more compact design which helps reduce hydraulic head loss in the fluid treatment system in which the radiation source module is placed.

A further advantage of the individualized cleaning sleeve approach of a preferred embodiment of the present cleaning apparatus is that it allows for easier removable and replacement of the UV lamp without the requirement to "break"
30 the seal between the cleaning sleeve and the radiation source. In other words, multiple or individual lamp removal can be achieved without breaching, in a preferred embodiment, the cleaning solution chamber in the cleaning sleeve. This

results in reduction of cleaning solution waste and improved efficiency in lamp maintenance of the radiation source module.

A particularly preferred embodiment of the present cleaning apparatus involves providing a spacing between the cleaning sleeve and the carriage which
5 allows the cleaning sleeve to "float" within the confines of the carriage in substantially the same direction that the carriage moves with respect to the radiation source assembly. More preferably, there is a gradient of such spacing between respective radiation source assemblies in a given module. Thus, the initial frictional force required to move the carriage is reduced. This is achieved
10 by step-wise deferral of the frictional force which must be overcome to move each cleaning sleeve. Thus, the maximum necessary actuation force is reduced since only the static force of a fraction of the cleaning sleeves in the module must be overcome at a given time. The advantage here is an overall reduction in lateral forces to which the radiation source assembly is subjected and in the overall force
15 needed to move the carriage. Further, this preferred embodiment allows for placement of the drive means above the series of radiation source assemblies in a given module.

BRIEF DESCRIPTION OF THE DRAWINGS

20 Embodiments of the present invention will be described with reference to the accompanying drawings, in which:

Figure 1 is a top view of fluid treatment system incorporating the present radiation source module;

Figure 2 is a sectional view taken along line II-II in Figure 1;

25 Figure 3 is a sectional view taken along line III-III in Figure 1;

Figure 4 is a side elevation of a first embodiment of the present radiation source module;

Figure 5 is an end elevation of the radiation source module illustrated in Figure 4;

30 Figure 6 is an enlarged sectional view taken along line VI-VI in Figure 5;

Figure 7 is a side elevation of a second embodiment of the present radiation source module;

Figure 8 is an end elevation of the radiation source module illustrated in Figure 7;

Figure 9 is an enlarged sectional view taken along line IX-IX in Figure 8;

Figure 10 is an enlarged sectional view taken along line X-X in Figure 8;

5 Figure 11 is an enlarged sectional view of connection of the radiation source assembly to the support leg in a preferred embodiment of the present radiation source module;

Figure 12 is a perspective view of various unassembled elements illustrated in Figure 11;

10 Figures 13-16 illustrated a simplified top view of removal of a radiation lamp from a radiation source assembly;

Figure 17 illustrates an embodiment of the carriage of the present cleaning apparatus which allows for two independent degrees of movement between the clean sleeves and the carriage.

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BEST MODE FOR CARRYING OUT THE INVENTION

With reference to Figures 1-3, there is illustrated a fluid treatment system 10. Fluid treatment system 10 comprises a channel 15 constructed of concrete 20. Channel 15 has an inlet 25 and an outlet 30 for receiving a flow of fluid (not shown).

20

Disposed in channel 15 is a plurality of radiation source modules 100. Each radiation source module 100 is connected to an electrical power supply 35 by an electrical lead 135.

As will be appreciated by those with skill in the art, fluid treatment system 10 illustrated in Figures 1-3 is a schematic only and has been greatly simplified to illustrate the arrangement of radiation source modules 100. As illustrated, it is preferred that radiation source modules 100 be arranged such that the elongated portions thereof are substantially parallel to the flow of fluid.

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With particular reference to Figure 3, a cradle 40 comprised of supports 41,42,43,44 is disposed in channel 15. As illustrated, support members 41,43 of cradle 40 are arranged transverse to the fluid flow in channel 15. Further, support members 42,44 are affixed to the sides of channel 15. Those with skill in the art

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will recognize that, in the illustrated embodiment, fluid treatment system 10 is designed such that the flow of fluid does not rise significantly above support member 43 of cradle 40.

5 The operation of fluid treatment system 10 is conventional and within the purview of a person skilled in the art. See, for example, the Maarschalkerweerd #1 Patents discussed herein above, the contents of which have been incorporated by reference herein above.

10 With reference to Figures 4-6, radiation source module 100 will now be described in more detail. Thus, radiation source module 100 comprises a pair of support legs 105,110 depending from a cross piece 115. Disposed between support legs 105,110 are a series of radiation source assemblies 120. Preferably, the exterior of each radiation source assembly 120 comprises a protective sleeve 107, more preferably made of quartz. The design of support legs 105,110 and radiation source assemblies 120 is preferably as is described in United States
15 Patents 4,872,980 and 5,006,244 referred to and incorporated by reference herein above. More preferably, it is preferred to design support leg 105 and/or support leg 110 to include a stop or similar means to avoid movement of the radiation source assemblies 120 during actuation of the present cleaning system.

20 With reference to Figures 11 and 12, further detail is provided on radiation source assembly 120, coupling socket 125 and support leg 105. Thus, coupling socket 125 is welded to support leg 105 via a bead 106. Coupling socket 125 receives quartz sleeve 107 having disposed therein a radiation (preferably ultraviolet radiation) lamp 108. Coupling socket 125 also receives a connection member 109. A sleeve nut 111 is in threaded engagement with
25 coupling socket 125 which serves to squeeze an O-ring 112 against quartz sleeve 107.

As shown, connection member 109 serves a number of purposes. First, it serves the purpose of connecting radiation lamp 108 to an electrical lead 113 which is fed to the ballast (not shown) incorporated in cross piece 115 or located
30 remotely from radiation source module 100. Second, connection member 109 is provided with a first sealing lip 114 and a pair of second sealing lips 116. First sealing lip 114 serves two purposes: (i) to prevent water from entering the space

between quartz sleeve 107 and radiation lamp 108 from support leg 105, and (ii) it is first seal to water entering support leg 105 (e.g., in the event that quartz sleeve 107 breaks) upon breakage of quartz sleeve 107. Lips 116 prevent water which may have leaked into support leg 105 from entering into radiation source assembly 120. Third, connection member 109 contains a stop 117 against which the open end of quartz sleeve 107 abuts thereby avoiding quartz sleeve 107 being damaged on contact with metal coupling socket 125. Fourth, connection member 109 contains a lip 118 of slightly larger diameter than the internal diameter of coupling socket 125 disposed in support leg 105. Lip 118 serves to affix connection member 109 in the correct position.

In a preferred embodiment of the connection scheme illustrated in Figures 11 and 12, a surface grounding lead 109A is provided (as a part of connection member 109) with one end connected to the inside of coupling socket 125 and the other end on the lamp side of first sealing lip 114 (e.g., in the lamp pin receptacle of connection member 109, in the space between connection member 109 and quartz sleeve 107, etc.). As will be appreciated by those of skill in the such an arrangement will allow for ground fault detection and automatic shutdown of the module (e.g., via a conventional Ground Fault Interrupt switch) in the event of breakage of quartz sleeve 107. The ground fault is used to detect water leakage.

Alternatively, the coupling of radiation source assemblies 120 to support leg 105 may be as described in United States Patents 4,872,980 and 5,006,244. This includes a "triple seal system" which serves to seal radiation source module 100 from fluid ingress: (i) at the connection between radiation source assembly 120 and coupling socket 125, (ii) into radiation source assembly 120, and (iii) into support leg 105. The latter two functions are particularly preferred since they will protect flooding of all radiation source assemblies 120 in module 100 in the event that a single radiation source assembly 120 is broken while submerged.

Another preferred feature of radiation source assembly 100 is the provision, preferably in cross piece 115 of a ballast (not shown) to control the radiation source in radiation source assemblies 120. Again, reference is made to previously mentioned and incorporated United States Patents 4,872,980 and

5,006,244 for a more detailed description of provision of a ballast in radiation source module 100.

Also disposed between support legs 105,110 is a U-shaped member 130. As will be appreciated by those with skill in the art, when a series of radiation source modules 100 are aligned in a side-by-side arrangement, the corresponding side-by-side arrangement of U-shaped members 130 in each module 100 serves to provide at least a coarse shield from escape of radiation while the radiation source modules 100 are in use. With further reference to Figure 4, an electrical lead 135 emanates from cross-piece 115. Preferably, electrical lead 135 is connected to a ballast (not shown) in cross piece 115. Also connected to this ballast is electrical lead 113 which is fed through a hollow passage in support leg 105 as described in United States Patents 4,872,980 and 5,006,244, mentioned above and incorporated by reference. If ballast is not incorporated in the module, electrical lead 113 is combined with other electrical leads from other radiation source assemblies 120 in a given module to form electrical lead 135 which is then connect to a ballast and supply of electricity remote to the module.

With further reference to Figure 4, a rodless cylinder 140 is disposed between support legs 105,110. Disposed on rodless cylinder 140 is a carriage 145. Carriage 145 comprises a series of cleaning sleeves 148a,148b,148c,148d and 149a,149b,149c,149d which will be described in more detailed herein below. Carriage 145 is connected to a slidable member 155 which is in sliding engagement with rodless cylinder 140.

Rodless cylinder 140 is connected to a pair of connection blocks 160,165 disposed on support legs 105,110, respectively. A first fluid pressurization line 170 is connected to connection block 160 and a second fluid pressurization line 175 is connected to connection block 165. Fluid pressurization lines 170,175 are connected to a source of pressurized fluid (not shown). This may be a source of hydraulic pressure or pneumatic pressure. The connections to and from connection blocks 160,165 are preferably made substantially fluid-tight in a conventional manner which is within the purview of a person of ordinary skill in the art.

With particular reference to Figure 6, a preferred form of the present cleaning apparatus is illustrated. As illustrated, carriage 145 comprises a pair of split plates 145a, 145b (for clarity, corresponding split plate 145b is not depicted in Figure 6). Split plate 145a of carriage 145 comprises a series of openings 146a, 146b, 146c, 146d on one side of rodless cylinder 140. On the other side of rodless cylinder 140, split plate 145a of carriage 145 comprises another series of openings 147a, 147b, 147c, 147d (see also Figure 4). Disposed in openings 146a, 146b, 146c, 146d is a cleaning sleeve 148a, 148b, 148c, 148d, respectively. Disposed in opening 147a is cleaning sleeve 149a. As will be appreciated by those of skill in the art, further cleaning sleeves 149 are disposed in further openings 147 (for clarity, these are not specifically illustrated in Figure 6). Each cleaning sleeve 148/149 comprises a pair of seals 151, 152, preferably in the form of O-rings, to define a chamber 153. As shown, a pair of drive cones 156, 157 serve to provide an interface between split plate 145a of carriage 145 and quartz sleeve 107. Preferably, drive cones 156, 157 are made of Teflon™.

As illustrated, cleaning sleeves 148/149 are interconnected by a hose 158. As will be appreciated by those of skill in the art, this allows for use of a single supply of cleaning solution to fill chamber 153 in each cleaning sleeve 148/149. Of course, those of skill in the art will recognize that it is possible to omit this interconnection approach and maintain independence between chamber 153 of each cleaning sleeve 148/149.

As shown, there is virtually no spacing between cleaning sleeve 148a and drive cones 156/157. A slight gap is provided between cleaning sleeve 148b and drive cones 156, 157. An even larger gap is provided between cleaning sleeve 148c and drive cones 156, 157. A yet larger gap is provided between cleaning sleeve 148d and drive cones 156, 157. As will be apparent to those of skill in the art, the increasing gap size was achieved by increasing the longitudinal dimension of openings 146a to 146d. This is preferred since it allows manufacture and use of a universally dimensioned cleaning sleeve 148. Of course, it is possible to modify the dimension of the cleaning sleeve in addition to or in place of modifying the dimension of the opening in split plate 145a of carriage 145.

Preferably, chamber 153 of cleaning sleeves 148/149 are filled with a cleaning solution (not shown), if desired. The nature of this cleaning solution is not particularly restricted provided care is taken that it is not so corrosive that components of the cleaning sleeve become damaged by contact with the cleaning solution.

5 With further reference to Figure 6, disposed within rodless cylinder 140 is a piston 180. Piston 180 comprises a series of permanent magnets 181. Permanent magnets 181 are in fluid sealing engagement with the interior of rodless cylinder 140. Disposed within slidable member 155 is a series of annular permanent magnets 182 which are aligned with permanent magnets 181. Preferably, opposed pairs of individual permanent magnets 181 and individual annular permanent magnets 182 have different poles thereby creating an attraction between slidable member 155 and piston 180. A magnetically coupled rodless cylinder such as the one illustrated herein is described in more detail in 10 United States Patents 3,779,401 [Carrol], 4,488,477 [Miyamoto] and 4,744,287 [Miyamoto], the contents of which are hereby incorporated by reference.

Preferably, slidable member 155 is in a fluid sealing engagement with rodless cylinder 140. This can be achieved in any suitable manner way. For example, a pair of annular seals (not shown) may be provided between slidable member 155 and rodless cylinder 140. The seal may be achieved by using an interference fit between slidable member 155 and rodless cylinder 140, the magnetic forces created by the coupling of slidable member 155 to piston 180 or a combination of these. The advantage of providing such a seal between slidable member 155 and rodless cylinder 140 is that the exposed surface of rodless cylinder 140 is wiped during operation thereby keeping it relatively clean to avoid jamming of the cleaning system.

Radiation source module 100 is used to treat wastewater in the manner described in the Maarschalkerweerd #1 Patents referred to herein above. After some period of use, the exterior of radiation source assemblies will become fouled with undesired materials such as organic matter (e.g., biofilm) and/or inorganic matter (e.g., scale). This can be readily determined from historical data gathered during operation of fluid treatment system 10. Once it is desired to

remove the undesired materials from the exterior of radiation source assemblies 120, a pressurized fluid is admitted through line 175 into rodless cylinder 140 via connection block 165. This serves to urge and translate slidable member 155 along rodless cylinder 140 (which in turn is coupled to carriage 145) toward support leg 105 until carriage 145 is positioned adjacent connection block 160 as shown at A in Figure 4. Thereafter, pressurized fluid is fed through fluid pressurization line 170 and connection block 160 to urge and translate slidable member 155 toward support leg 110 (in the illustrated embodiment, this is the "parked position" of slidable member 155). Thus, those with skill in the art will immediately recognize that slidable member 155 and carriage 145 connected thereto operate to remove undesired materials from the exterior of radiation source assemblies 120 in a reciprocal manner. One of the key advantages of radiation source module 100 is that, once historical data on frequency of cleaning needed has been gathered, the cleaning operation can be substantially automated allowing for in situ cleaning of the exterior of radiation sources assemblies 120 without the need to remove modules and/or shut down fluid treatment system 10.

With reference to Figure 6, once slidable member 155 is urged and translated along rodless cylinder 140, carriage 145 is translated thereby abutting and translating each cleaning sleeves 148/149. By providing a gradient of spacing between adjacent cleaning sleeves 146 and adjacent cleaning sleeves 147 as described herein above, carriage 145 meets with significantly less frictional resistance to initial movement when compared to a scenario wherein all the cleaning sleeves are abutted by carriage 145 at the same time. This is a particular advantage of the specifically illustrated embodiment. An additional benefit of rodless cylinder 140 is that it can obviate the need for a supplementary support between support legs 105, 110 - e.g., the one illustrated (11) in United States patent 4,482,809 referred herein above.

With reference to Figures 7-10, another embodiment of the present radiation source module is illustrated. For clarity, elements in Figures 7-10 which correspond to like elements in Figures 4-6 have the same last two digits with a different first digit. Thus, for example, whereas radiation source module

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100 is illustrated in Figures 4-6, radiation source 200 is illustrated in Figures 7-10.

The principal difference between radiation source module 100 illustrated in Figures 4-6 and radiation source module 200 illustrated in Figures 7-10 is that, in the latter, piston 280a is engaged with a screw member 290. Screw member
5 290 is driven by a motor 292 (preferably a DC motor) disposed in cross-piece 215. An electrical lead 294 emanates from motor 292 and is connected to a source of electricity (not shown). Motor 292 drives a shaft 296 which is disposed in support leg 210a. Shaft 296 is engaged with screw member 290 by a conventional bevel gear (not shown) disposed in connection block 265a. Those
10 of skill in the art will recognize that motor 292 is reversible so that rotation of screw member 290 may be reversed.

Radiation source module 200 illustrated in Figures 7-10 may be used in a manner similar to that discussed herein above for radiation source module 100 illustrated in Figures 4-6. Thus, once it is desired to remove the undesired
15 materials from the exterior of radiation source assemblies 220, motor 292 is actuated thereby rotating screw member 290. This serves to urge and translate slidable member 255 along rodless cylinder 240 (which in turn is coupled to cleaning sleeve 245) toward support leg 205. Once slidable member 255 is adjacent to support leg 205, the drive of electric motor 292 is reversed thereby
20 reversing rotation of screw member 290, and urging and translating slidable member 155 toward support leg 210a.

With reference to Figures 13-16, a particular advantage of the present cleaning apparatus is illustrated. Thus, when a lamp in the radiation source module needs to be replaced, sleeve nut 111 is disengaged from coupling socket
25 125 and split plate 145a is disengaged from carriage 145. With carriage 145 in the parked position (as described above), quartz sleeve 107 may be moved laterally to permit withdrawal of radiation lamp 108. The advantage is that this can be done to replace a single lamp without the need to disengage the quartz sleeves for the remaining lamps in module 100. Another key advantage is
30 replacement of radiation lamp 108 may be accomplished without the need to "break" the seal between cleaning sleeve 148/149 and the respective quartz sleeve. This greatly simplifies maintenance of module 100 in the field and

reduces the associated costs thereof. Thus, Figures 13 and 14 illustrate lateral displacement of quartz sleeve 107 to permit removal of radiation lamp 108 and Figures 15 and 16 illustrate the unit before/after lamp replacement.

While the present invention has been described with reference to preferred
5 and specifically illustrated embodiments, it will of course be understood by those
of skill in the arts that various modifications to these preferred and illustrated
embodiments may be made without the parting from the spirit and scope of the
invention. For example, it is possible to modify the design of split plates
145a/145b of carriage 145 as shown in Figure 17 to enhance the ability of the
10 radiation source assembly and the cleaning sleeve to move in the direction of
arrows B (i.e., in addition to the degree of longitudinal movement illustrated).
Further, while the illustrated embodiments of the present cleaning system related
to a cleaning sleeve which is sealed to provide a cleaning chamber, the invention
is intended to cover other cleaning sleeves such as those without a sealed
15 chamber (e.g., an O-ring wiper arrangement) and those which comprise
mechanical brushes. Further, the particular manner of urging and translating the
drive member within the rodless cylinder is not restricted. In this regard, the
drive member could be urged and translated using a series of cables and pulleys
connected to a drive block typically (but not necessarily) located above the water
20 level (e.g., a cable could be connected to each end of the piston in the rodless
cylinder and fed out of opposed ends of the rodless cylinder and routed to the
drive block via a suitable arrangement of pulleys). Further, it is not necessary to
have a pair of opposed, laterally spaced support legs. Specifically, it is possible
to modify the specific illustrated embodiment of the present radiation source
25 module to a "single legged" module such as the one described in the
Maarschalkerweerd #2 Patents. Still further, it is possible to have a plurality of
cleaning sleeves per module. Still further, it is possible to modify the
specifically illustrated embodiment such that the cleaning sleeve comprises of
single wiper in place of an annular chamber surrounding the exterior of the
30 radiation source assembly and containing a cleaning fluid. Still further, it is
possible to modify the illustrated radiation source module to include two parking
locations for the cleaning sleeve located adjacent the respective support legs (i.e.,

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in this case a single stroke of the rodless cylinder would be a cleaning cycle whereas, in the illustrated embodiment, a double stroke of the rodless cylinder would be a cleaning cycle). Still further, if the rodless cylinder is operated by fluid pressurization, it possible to modify the illustrated embodiment to include
5 the fluid pressurization lines in the respective support legs of the module thereby obviating additional hydraulic head loss. Alternatively, the illustrated embodiment could be modified to include a hydraulically streamline shield disposed upstream of the upstream support leg of the module. Still further, it is possible to modify the illustrated embodiment to utilize a rodless cylinder having
10 a single port connected to a fluid pressurization source. In this modification, the single port would act as both a fluid inlet and a fluid outlet. For example, in one stroke of the rodless cylinder, the single port could be used to admit pressurized fluid and, in the reverse stroke, the single port could be used to draw a vacuum or as an exhaust (e.g., by the use of a spring or other biasing member located
15 inside the rodless cylinder at the end opposite to the single inlet). Other modifications will be readily apparent to those with skill in the art.

What is claimed is:

1. A cleaning apparatus for a radiation source assembly in a fluid treatment system, the cleaning system comprising:
 - a carriage movable with respect to an exterior of the radiation source assembly;
 - at least one cleaning sleeve in sliding engagement with the exterior of the radiation source assembly, the at least one cleaning sleeve being moveable with respect to the carriage; and
 - drive means coupled to the carriage to translate the carriage whereby the at least one cleaning sleeve is translated over the exterior of the radiation source assembly.
2. The cleaning apparatus defined in claim 1, wherein the at least one cleaning sleeve is rotationally moveable with respect to the carriage.
3. The cleaning apparatus defined in claim 1, wherein the at least one cleaning sleeve is moveable with respect to the carriage in substantially the same direction as the carriage is moveable with respect to the exterior of the radiation source assembly.
4. The cleaning apparatus defined in claim 1, wherein a spacing is provided between the at least one cleaning sleeve and the carriage.
5. The cleaning apparatus defined in claim 1, wherein the at least one cleaning sleeve is moveable with respect to the carriage in a direction substantially orthogonal to the direction in which the carriage is moveable with respect to the exterior of the radiation source assembly.
6. The cleaning apparatus defined in claim 1, wherein the carriage is mechanically coupled to the drive means.

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7. The cleaning apparatus defined in claim 6, wherein the drive means comprises a screw drive.
8. The cleaning apparatus defined in claim 1, wherein the carriage is magnetically coupled to the drive means.
9. The cleaning apparatus defined in claim 8, wherein the drive means comprises a rodless cylinder.
10. The cleaning apparatus defined in claim 9, wherein the rodless cylinder comprises a driving member disposed in a housing, the driving member being axially slidable within the housing.
11. The cleaning apparatus defined in claim 8, wherein the drive means is operable by a fluid pressurization source.
12. The cleaning apparatus defined in claim 8, wherein the drive means is operable by a fluid vacuum source.
13. The cleaning apparatus defined in claim 11, wherein the fluid pressurization source is connected to a first port which is in communication with the rodless cylinder, the first port acting alternately as a fluid inlet and fluid outlet.
14. The cleaning apparatus defined in claim 11, wherein the fluid pressurization source is connected to a first port and a second port which are in communication with the rodless cylinder.
15. The cleaning apparatus defined in claim 11, wherein the fluid pressurization source comprises a source of hydraulic pressure.

16. The cleaning apparatus defined in claim 11, wherein the fluid pressurization source comprises a source of pneumatic pressure.
17. The cleaning apparatus defined in claim 8, wherein the rodless cylinder is submersible in a fluid to be treated.
18. The cleaning apparatus defined in claim 1, comprising a plurality of cleaning sleeves.
19. The cleaning apparatus defined in claim 1, comprising at least one pair of cleaning sleeves opposed with respect to the drive means.
20. The cleaning apparatus defined in claim 19, wherein a spacing is provided between at least one of the cleaning sleeves and the carriage.
21. The cleaning apparatus defined in claim 1, comprising a first plurality of cleaning sleeves and a second plurality of cleaning sleeves which are opposed with respect to the drive means.
22. The cleaning apparatus defined in claim 21, wherein a spacing is provided between at least one of the first plurality of cleaning sleeves and the carriage.
23. The cleaning apparatus defined in claim 22, comprising a gradient in the dimension of the spacing between the first plurality of cleaning sleeves and the carriage.
24. The cleaning apparatus defined in claim 21, wherein a spacing is provided between at least one of the second plurality of cleaning sleeves and the carriage.
25. The cleaning apparatus defined in claim 24, comprising a gradient in the dimension of the spacing between the second plurality of cleaning sleeves and the carriage.

26. The cleaning apparatus defined in claim 21, wherein a spacing is provided between at least one of the first plurality of cleaning sleeves and the carriage, and at least one of the second plurality of cleaning sleeves and the carriage.
27. The cleaning apparatus defined in claim 26, comprising a first gradient in the dimension of the spacing between the first plurality of cleaning sleeves and the carriage, and a second gradient in the dimension of the spacing between the second plurality of cleaning sleeves and the carriage.
28. The cleaning apparatus defined in claim 1, wherein the cleaning sleeve comprises a seal for sealing engagement with the portion of the exterior of the radiation source assembly, the seal removing a portion of undesired materials from the exterior of the radiation source assembly when the carriage is translated with respect to the exterior of the radiation source.
29. The cleaning apparatus defined in claim 1, wherein the cleaning sleeve comprises a substantially sealed chamber for surrounding a portion of the exterior of the radiation source assembly.
30. The cleaning apparatus defined in claim 29, wherein the cleaning sleeve further comprises an inlet for introduction of a cleaning solution to the chamber.
31. A radiation source module for use in a fluid treatment system, the module comprising:
- a frame having a first support member;
 - at least one radiation source assembly extending from and in sealing engagement with the first support member, the at least one radiation source assembly comprising a radiation source;
 - cleaning means to remove undesired materials from an exterior of the at least one radiation source assembly, the cleaning means comprising:

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a carriage movable with respect to an exterior of the radiation source assembly;

at least one cleaning sleeve in sliding engagement with the exterior of the radiation source assembly, the at least one cleaning sleeve being moveable with respect to the carriage; and

drive means coupled to the carriage to translate the carriage whereby the at least one cleaning sleeve is translated over the exterior of the radiation source assembly.

32. The radiation source module defined in claim 31, the frame further comprises a second support member opposed to and laterally spaced from the first support member, the at least one radiation source assembly disposed between each of the first support member and the second support member.

33. The radiation source module defined in claim 32, the frame further comprises a third support member interconnecting the first support member and the second support member.

34. The radiation source module defined in claim 31, wherein the frame further comprises a ballast for controlling the radiation source.

35. The radiation source module defined in claim 31, wherein the first support member comprises a hollow passageway for receiving a lead wire for conveying electricity to the radiation source.

36. The radiation source module defined in claim 31, wherein the radiation source assembly comprises a protective sleeve surrounding the radiation source.

37. The radiation source module defined in claim 36, wherein the protective sleeve comprises a quartz sleeve.

38. The radiation source module defined in claim 36, wherein the protective sleeve has an open end in sealed engagement with an opening in the first support member and a closed end supported by the second support member.
39. The radiation source module defined in claim 31, wherein the at least one cleaning sleeve is rotationally moveable with respect to the carriage.
40. The radiation source module defined in claim 31, wherein the at least one cleaning sleeve is moveable with respect to the carriage in substantially the same direction as the carriage is moveable with respect to the exterior of the radiation source assembly.
41. The radiation source module defined in claim 31, wherein a spacing is provided between the at least one cleaning sleeve and the carriage.
42. The radiation source module defined in claim 31, wherein the at least one cleaning sleeve is moveable with respect to the carriage in a direction substantially orthogonal to the direction in which the carriage is moveable with respect to the exterior of the radiation source assembly.
43. The radiation source module defined in claim 31, wherein the carriage is mechanically coupled to the drive means.
44. The radiation source module defined in claim 43, wherein the drive means comprises a screw drive.
45. The radiation source module defined in claim 31, wherein the carriage is magnetically coupled to the drive means.
46. The radiation source module defined in claim 45, wherein the drive means comprises a rodless cylinder.

47. The radiation source module defined in claim 46, wherein the rodless cylinder comprises a driving member disposed in a housing, the driving member being axially slidable within the housing.

48. The radiation source module defined in claim 46, wherein the drive means is operable by a fluid pressurization source.

49. The radiation source module defined in claim 46, wherein the drive means is operable by a fluid vacuum source.

50. The radiation source module defined in claim 48, wherein the fluid pressurization source is connected to a first port which is in communication with the rodless cylinder, the first port acting alternately as a fluid inlet and fluid outlet.

51. The radiation source module defined in claim 48, wherein the fluid pressurization source is connected to a first port and a second port which are in communication with the rodless cylinder.

52. The radiation source module defined in claim 48, wherein the fluid pressurization source comprises a source of hydraulic pressure.

53. The radiation source module defined in claim 48, wherein the fluid pressurization source comprises a source of pneumatic pressure.

54. The radiation source module defined in claim 46, wherein the rodless cylinder is submersible in a fluid to be treated.

55. The radiation source module defined in claim 31, wherein the cleaning means comprises a plurality of cleaning sleeves.

56. The radiation source module defined in claim 31, wherein the cleaning means at least one pair of cleaning sleeves opposed with respect to the drive means.
57. The radiation source module defined in claim 55, wherein a spacing is provided between at least one of the cleaning sleeves and the carriage.
58. The radiation source module defined in claim 31, wherein the cleaning means comprises a first plurality of cleaning sleeves and a second plurality of cleaning sleeves which are opposed with respect to the drive means.
59. The radiation source module defined in claim 58, wherein a spacing is provided between at least one of the first plurality of cleaning sleeves and the carriage.
60. The radiation source module defined in claim 59, comprising a gradient in the dimension of the spacing between the first plurality of cleaning sleeves and the carriage.
61. The radiation source module defined in claim 58, wherein a spacing is provided between at least one of the second plurality of cleaning sleeves and the carriage.
62. The radiation source module defined in claim 61, comprising a gradient in the dimension of the spacing between the second plurality of cleaning sleeves and the carriage.
63. The radiation source module defined in claim 58, wherein a spacing is provided between at least one of the first plurality of cleaning sleeves and the carriage, and at least one of the second plurality of cleaning sleeves and the carriage.

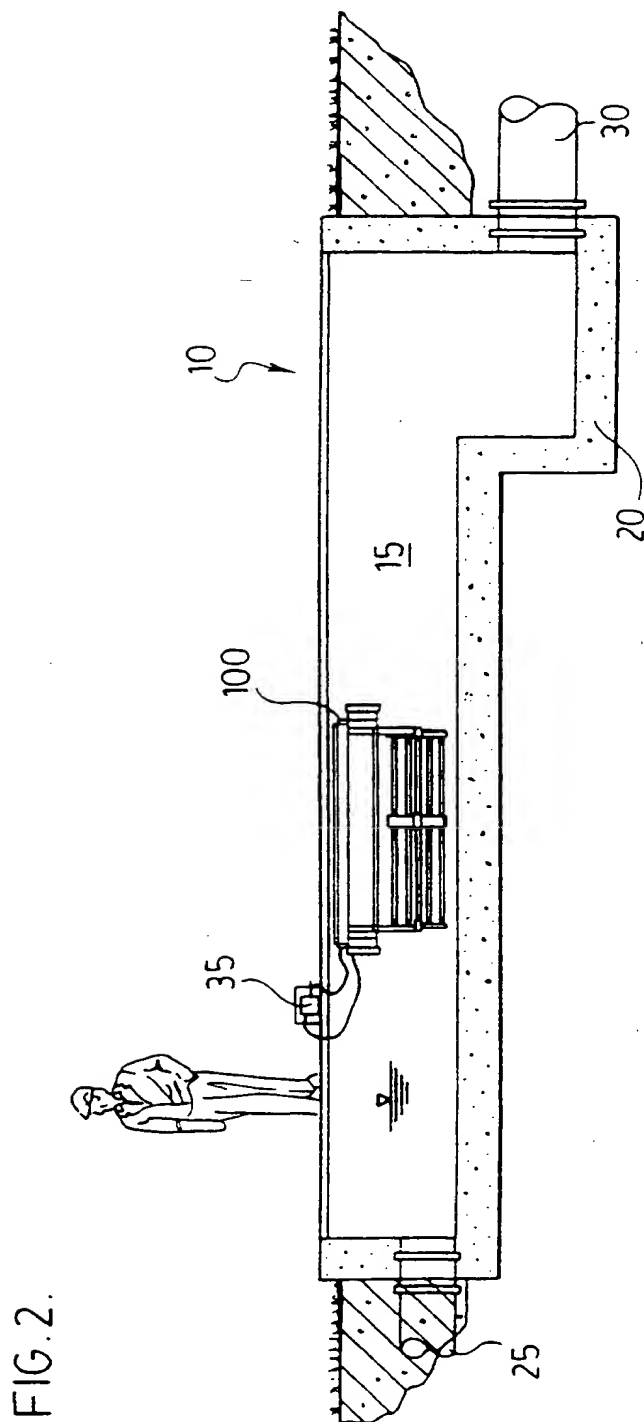
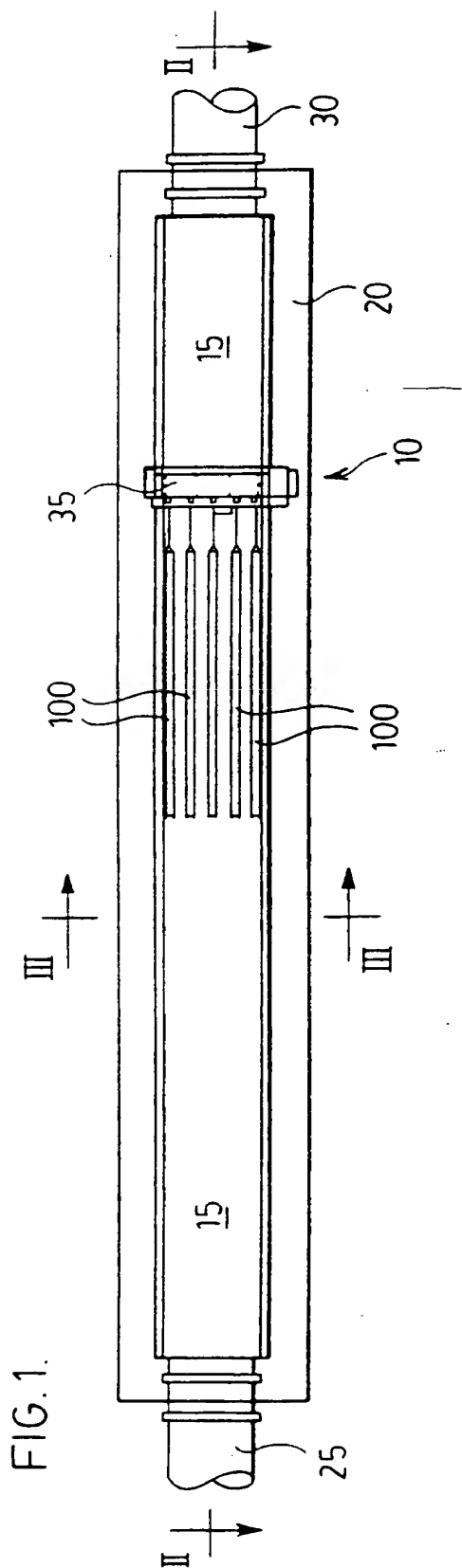
64. The radiation source module defined in claim 63, comprising a first gradient in the dimension of the spacing between the first plurality of cleaning sleeves and the carriage, and a second gradient in the dimension of the spacing between the second plurality of cleaning sleeves and the carriage.

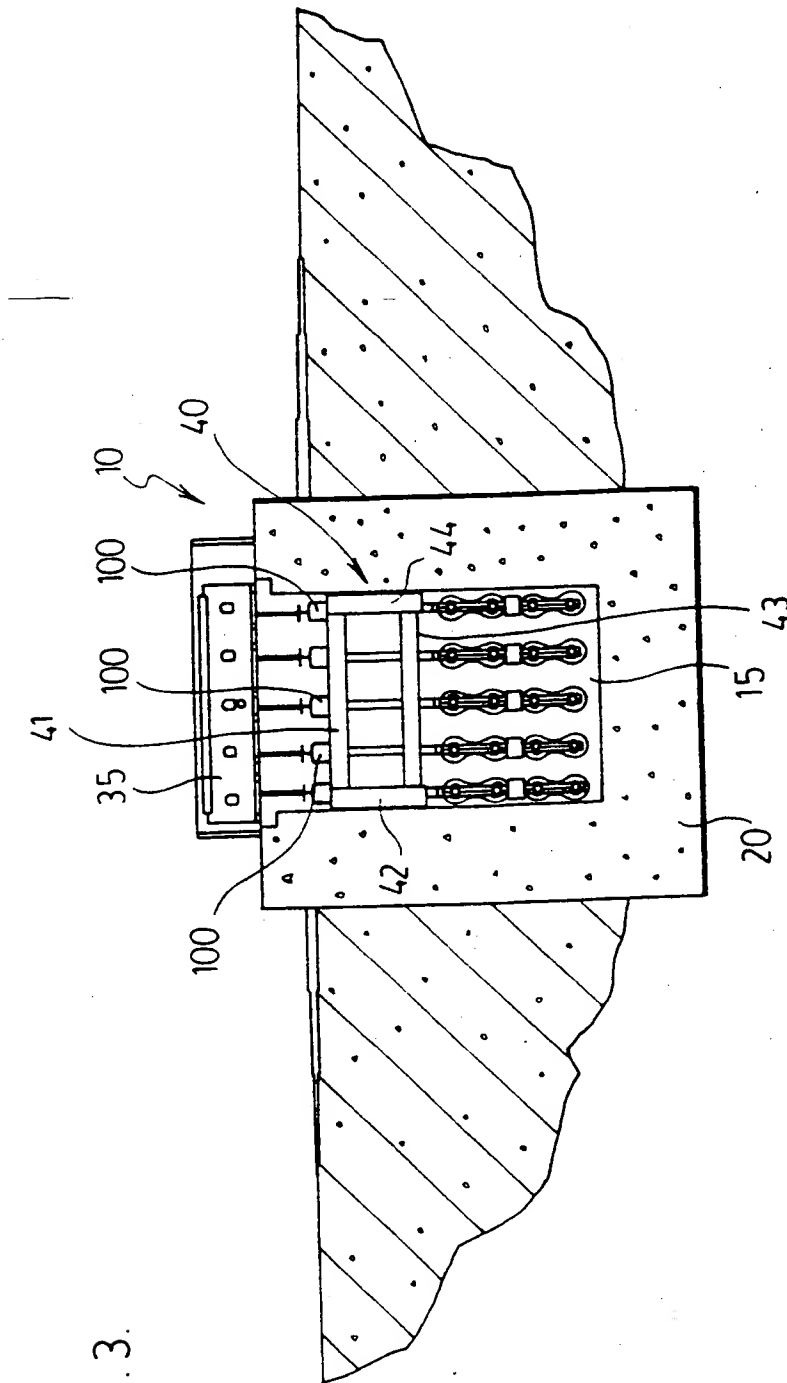
65. The radiation source module defined in claim 31, wherein the cleaning sleeve comprises a seal for sealing engagement with the portion of the exterior of the radiation source assembly, the seal removing a portion of undesired materials from the exterior of the radiation source assembly when the carriage is translated with respect to the exterior of the radiation source.

66. The radiation source module defined in claim 31, wherein the cleaning sleeve comprises a substantially sealed chamber for surrounding a portion of the exterior of the radiation source assembly.

67. The radiation source module defined in claim 66, wherein the cleaning sleeve further comprises an inlet for introduction of a cleaning solution to the chamber.

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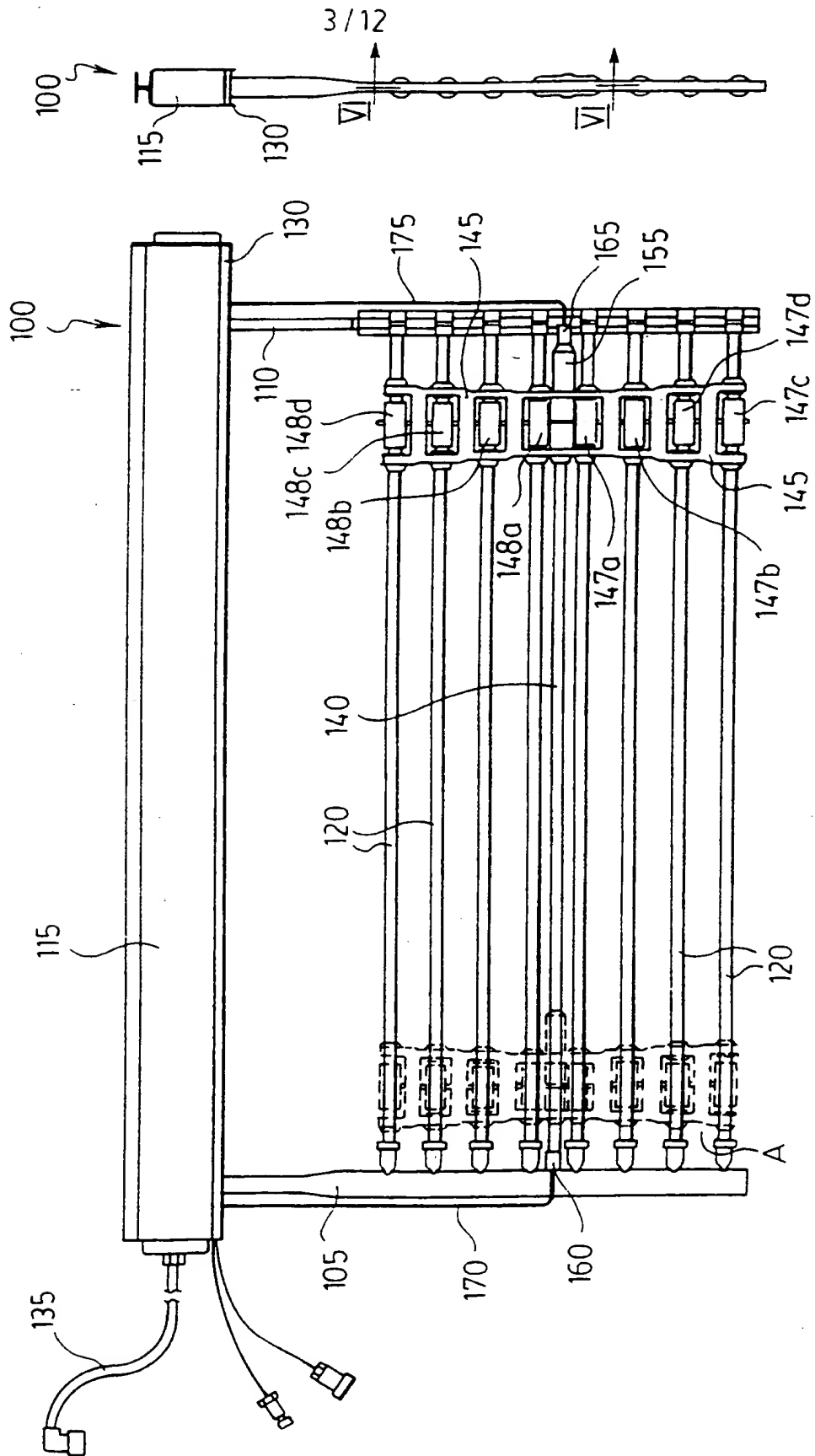
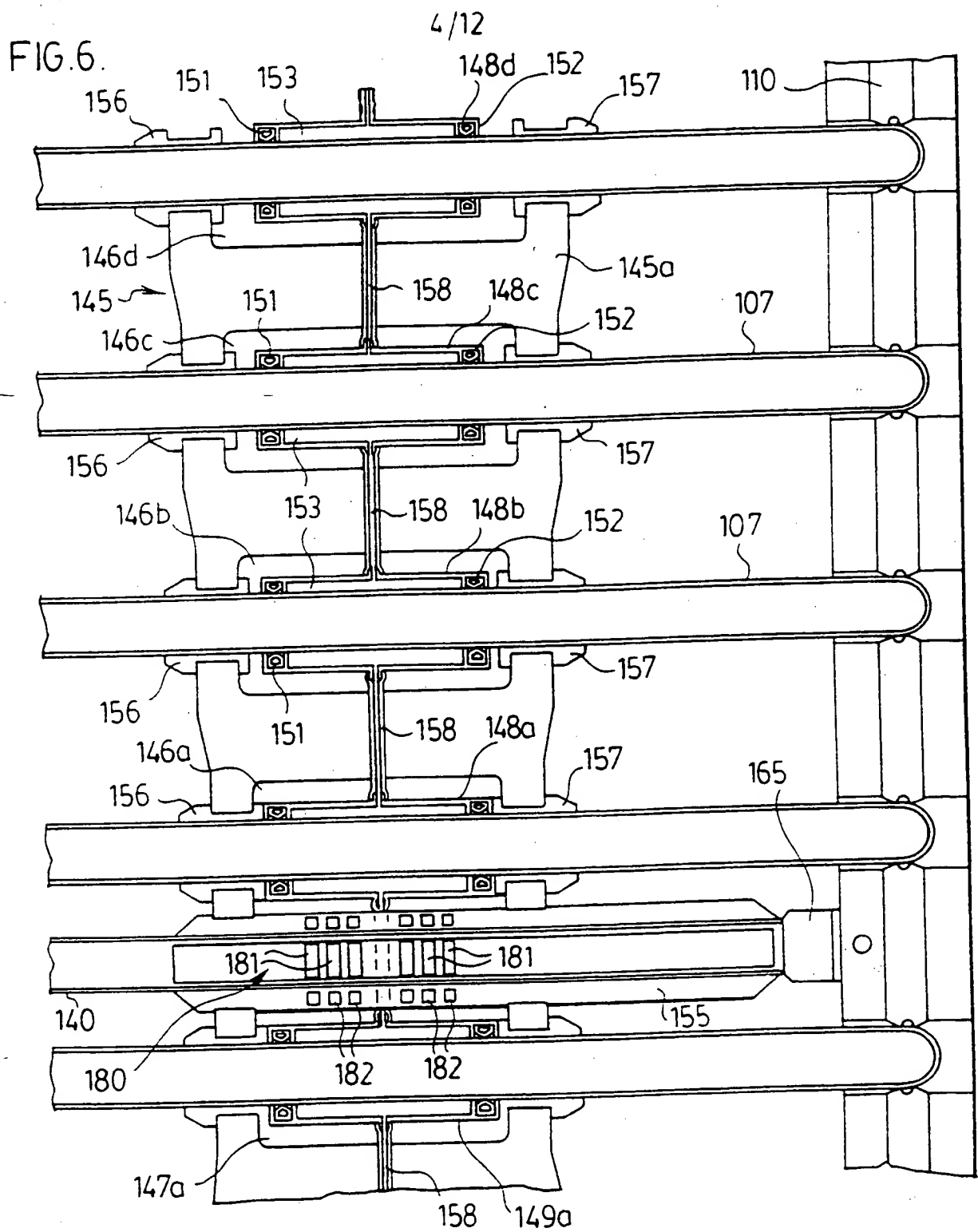


FIG. 5.

FIG. 4.



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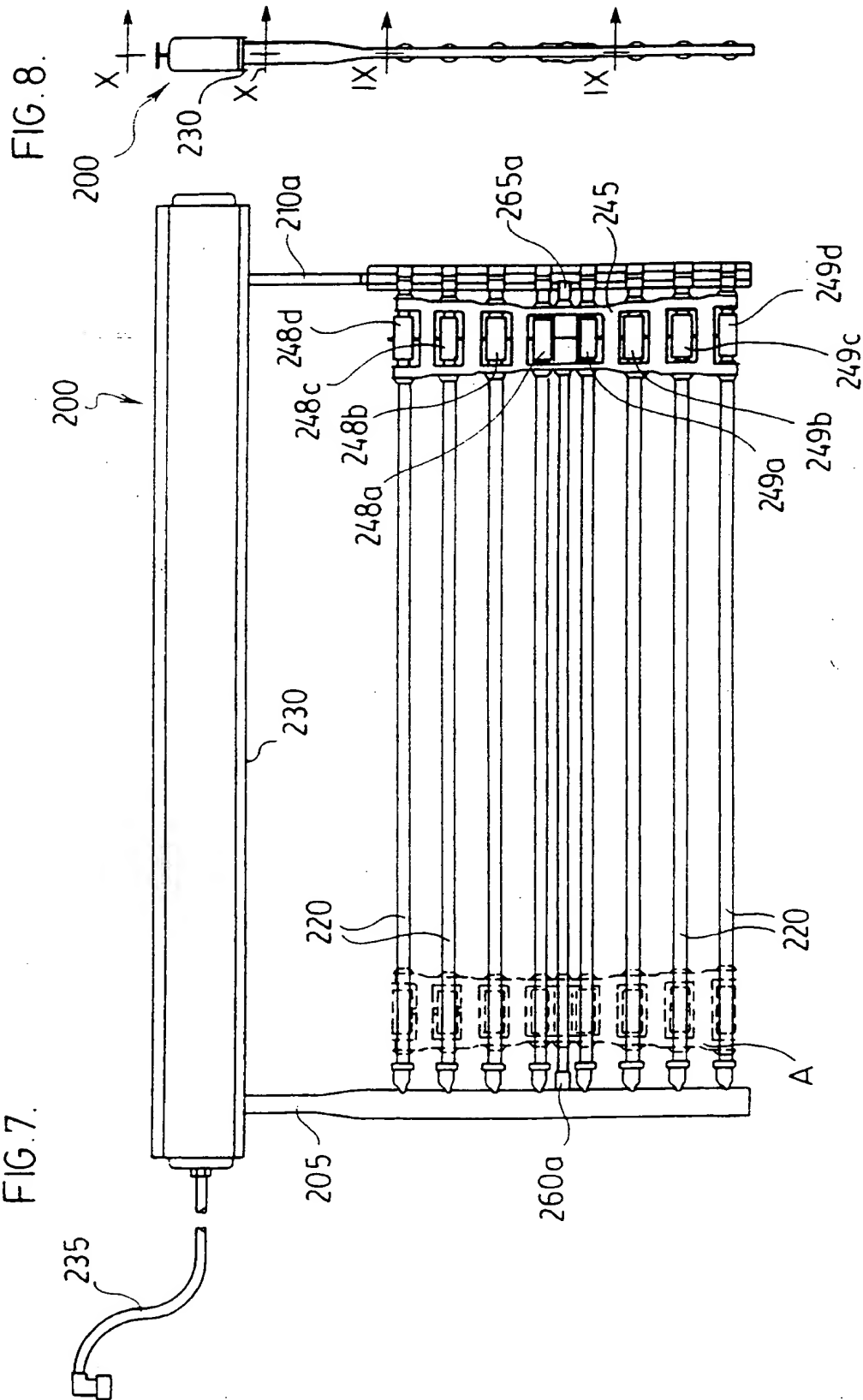
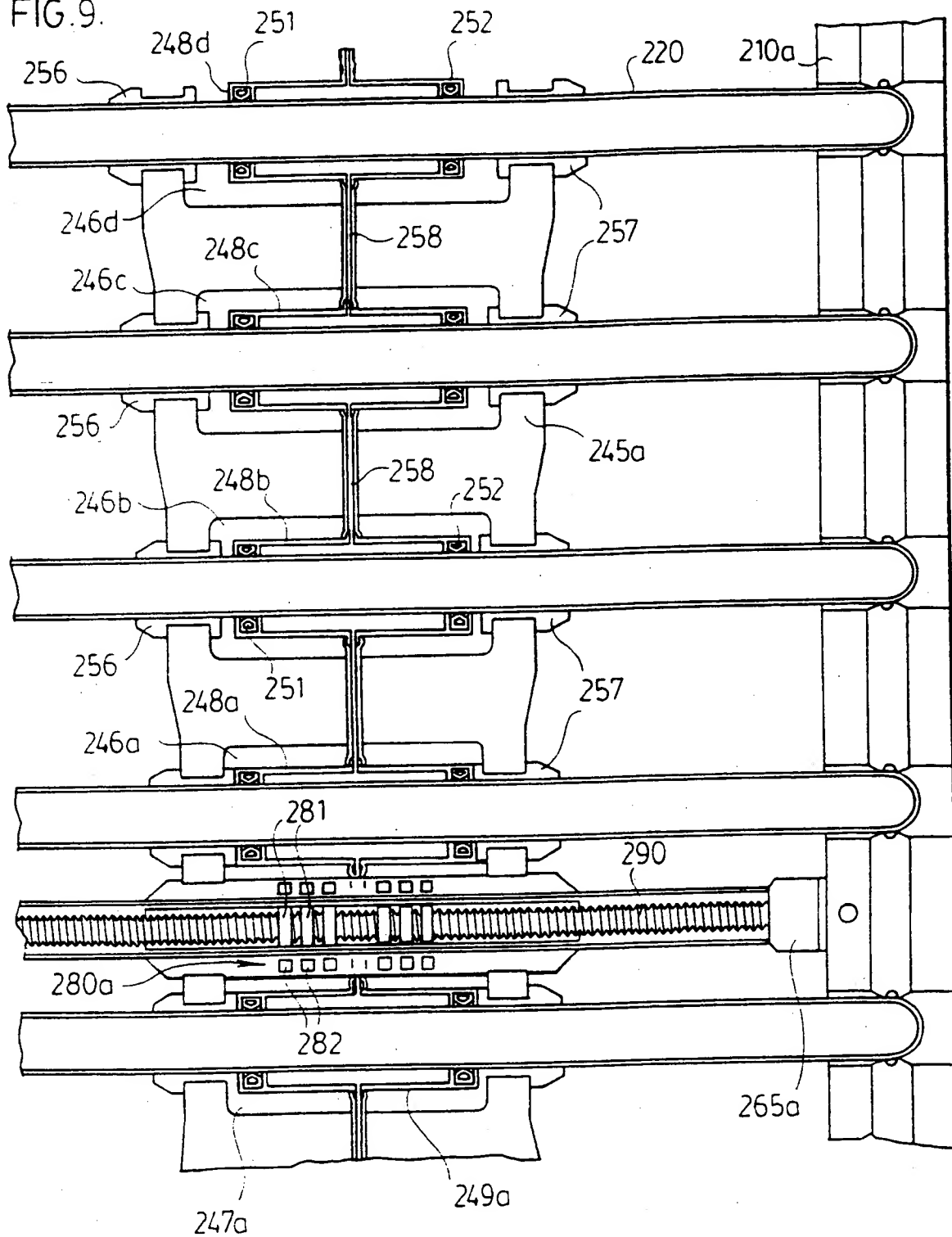


FIG. 9.



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FIG. 10.

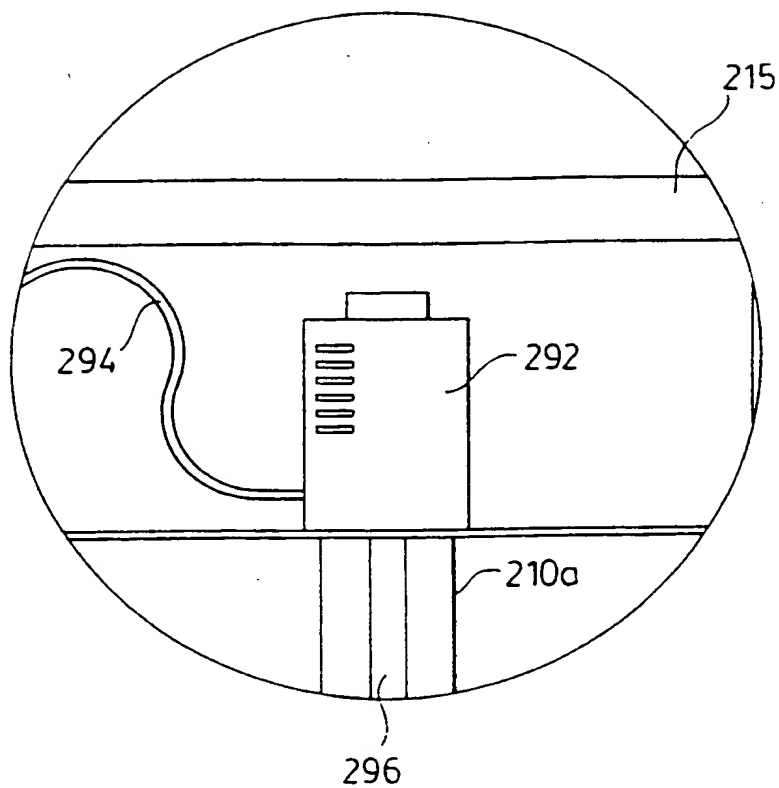
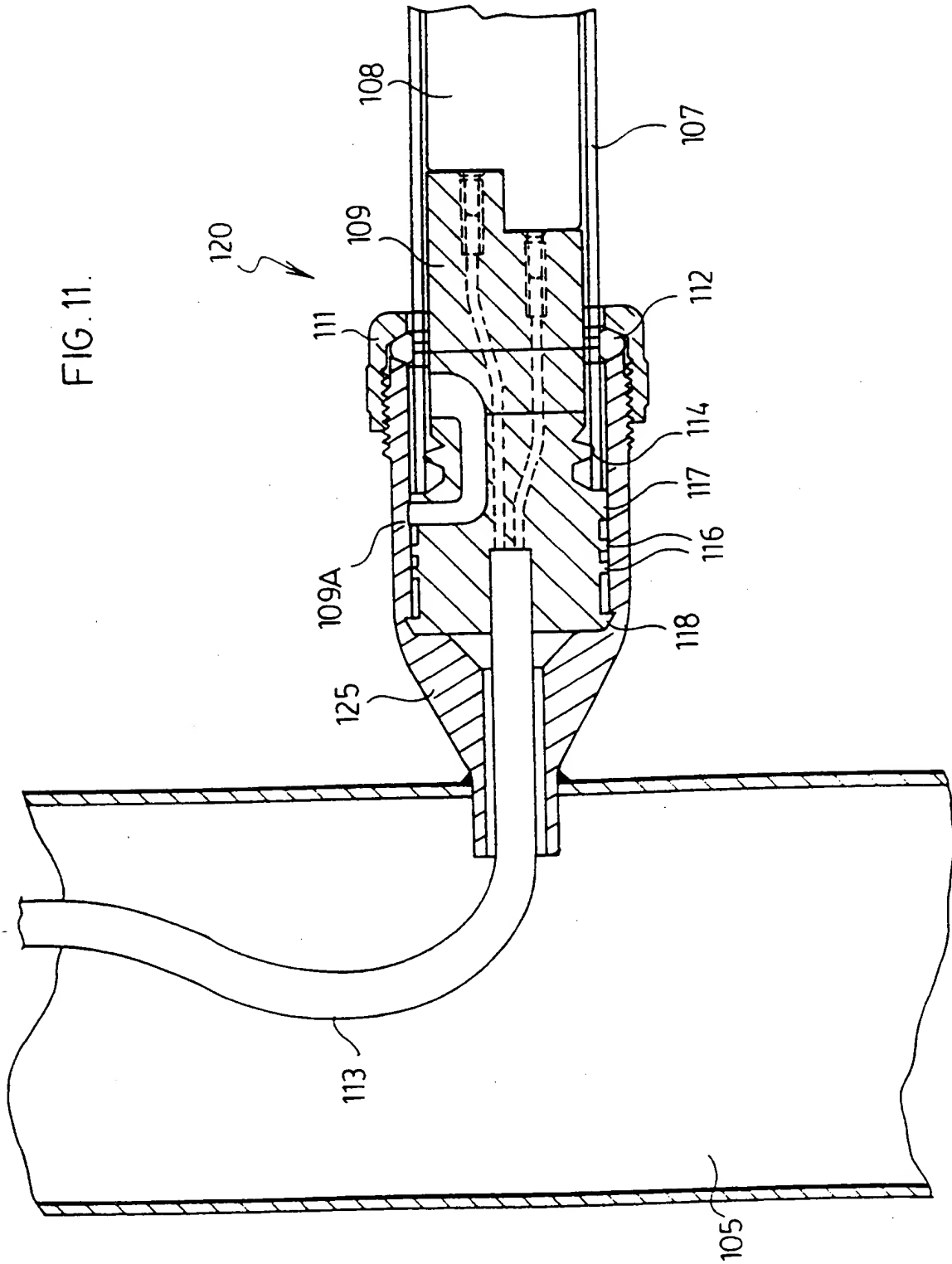


FIG. 11.



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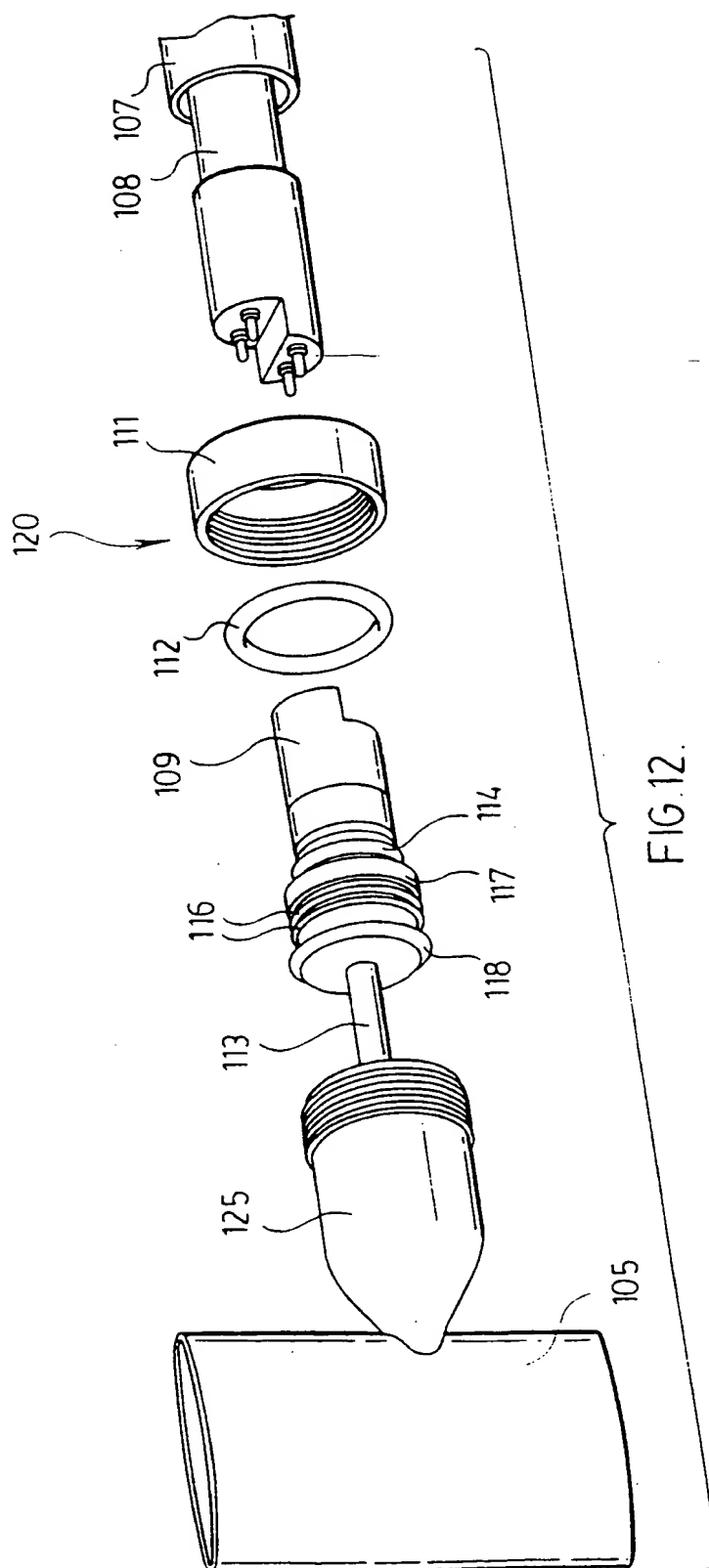
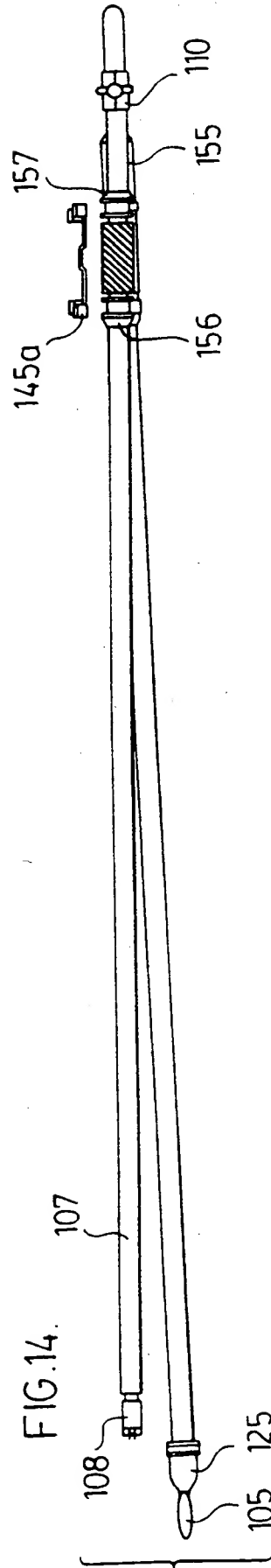
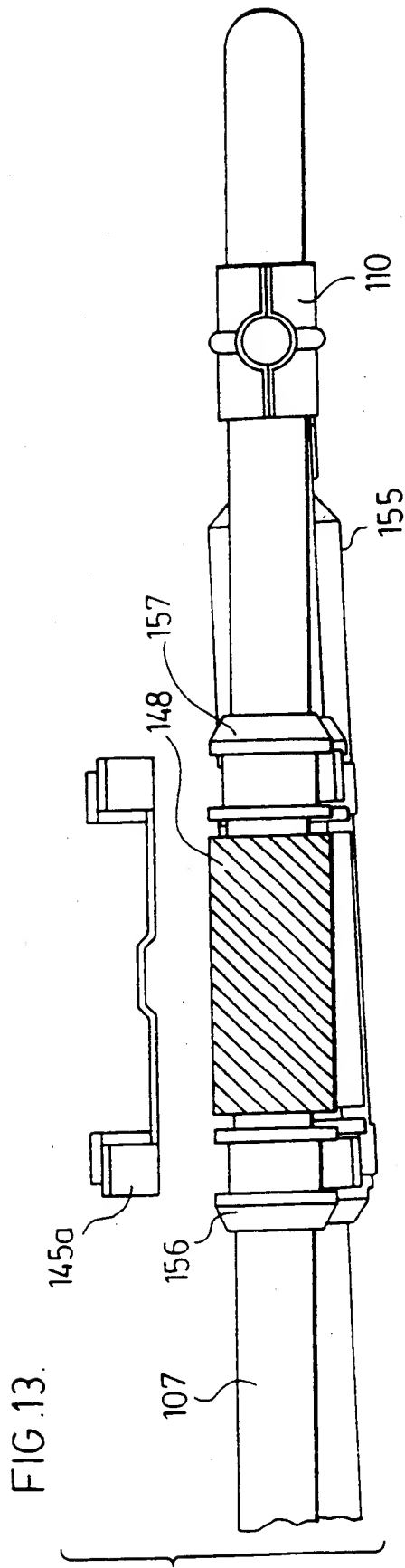


FIG. 12.



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FIG.15.

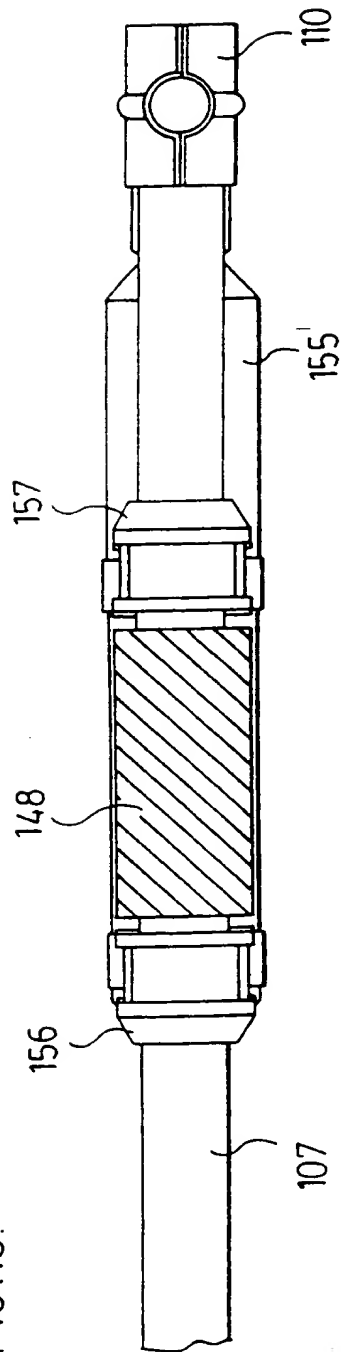
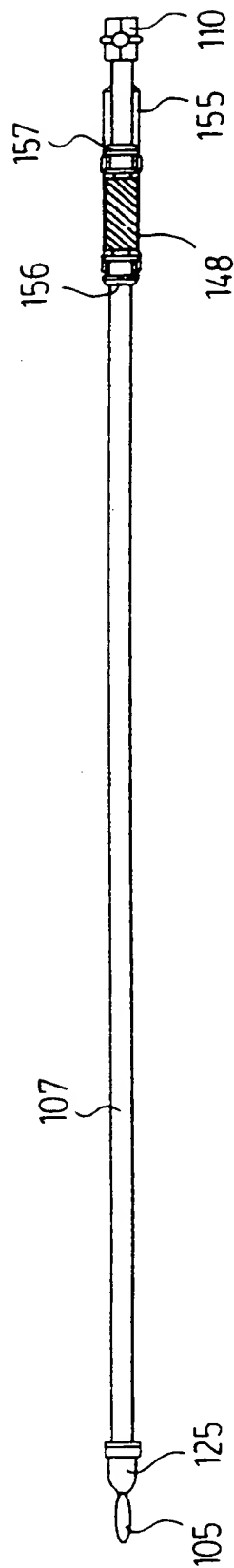
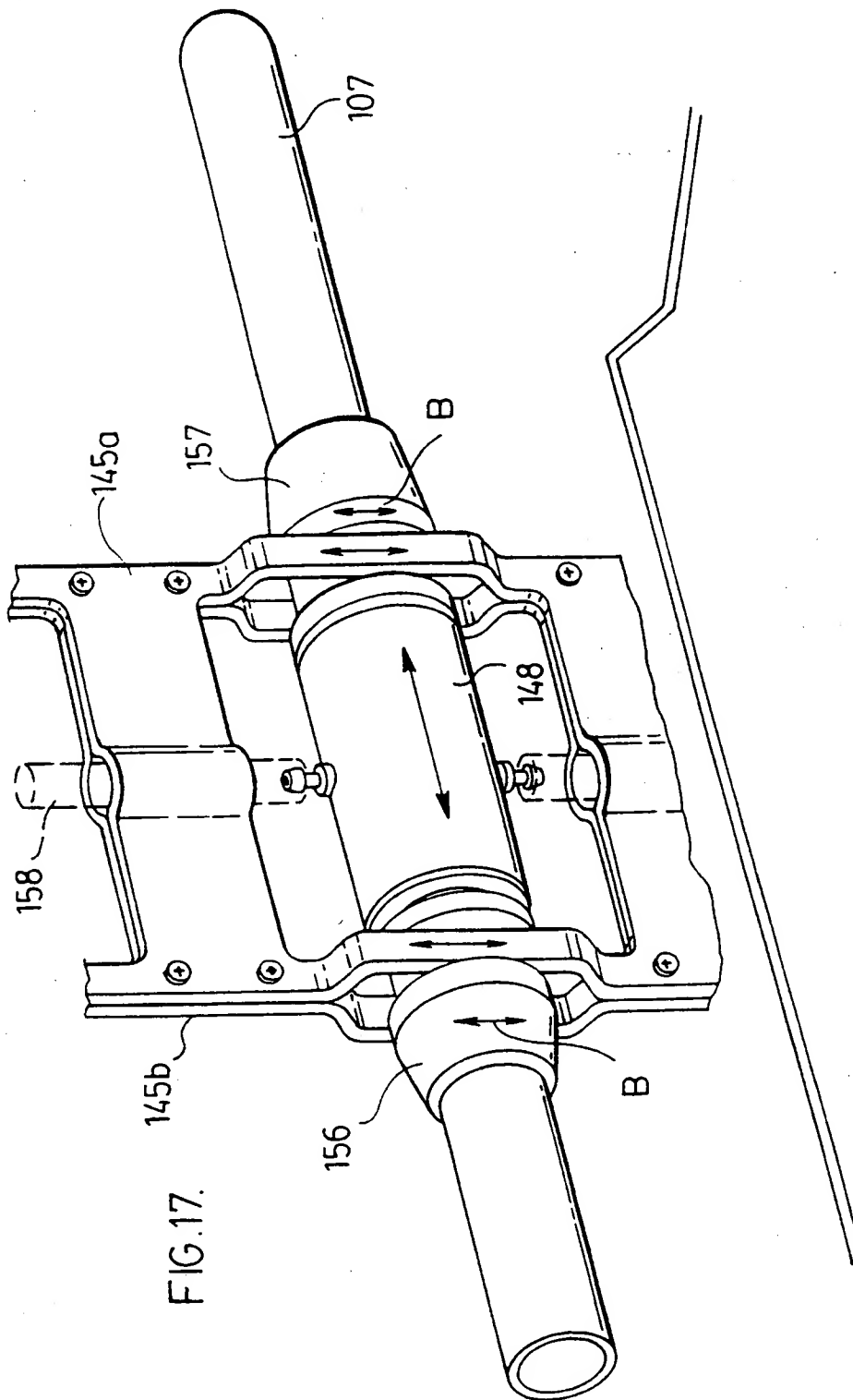


FIG.16.



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INTERNATIONAL SEARCH REPORT

Int'l Application No

PCT/CA 00/00192

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 C02F1/32

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 C02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	US 5 937 266 A (KADOYA MASAHIRO) 10 August 1999 (1999-08-10) column 6, line 46 -column 7, line 26 figures 3,6	1-4, 6, 7, 18-20, 31-33, 36-42, 44, 55-57
A	US 4 367 410 A (WOOD MYRON D) 4 January 1983 (1983-01-04) column 5, line 64 -column 6, line 62 figures 1,3,7	1-67
A	WO 98 27011 A (WEDECO GMBH ;WEDEKAMP HORST (DE)) 25 June 1998 (1998-06-25) the whole document figure 1	1-67
-/--		

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *&* document member of the same patent family

Date of the actual completion of the international search

17 May 2000

Date of mailing of the international search report

05/06/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Miebach, V

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 14, 31 December 1998 (1998-12-31) & JP 10 249335 A (NIPPON PHOTO SCI:KK), 22 September 1998 (1998-09-22) abstract figure	1-67

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/CA 00/00192

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5937266	A	10-08-1999	NONE	
US 4367410	A	04-01-1983	NONE	
WO 9827011	A	25-06-1998	DE 19653083 A AU 6480298 A EP 0946424 A	25-06-1998 15-07-1998 06-10-1999
JP 10249335	A	22-09-1998	NONE	

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ATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

To:
GOWLING LAFLEUR HENDERSON LLP
Attn. Nassif, Omar A.
Suite 4900
Commerce Court West
Toronto, Ontario M5L 1J3
CANADA

RECEIVED

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL SEARCH REPORT
OR THE DECLARATION

MAY 16 2002

GOWLING LAFLEUR HENDERSON LLP (PCT Rule 44.1)
PATENT DEPARTMENT

Date of mailing
(day/month/year) 08/05/2002

Applicant's or agent's file reference

T8465802W0

FOR FURTHER ACTION

See paragraphs 1 and 4 below

International application No.

PCT/CA 01/00816

International filing date

(day/month/year) 06/06/2001

Applicant

TROJAN TECHNOLOGIES INC.

1. ☒ The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ With regard to the protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

Within **19 months** from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within **20 months** from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority



European Patent Office, P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Peggy Frenzel

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NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

When?

Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

How?

Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

What documents must/may accompany the amendments?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference T8465802W0	FOR FURTHER ACTION <small>see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.</small>	
International application No. PCT/CA 01/00816	International filing date (day/month/year) 06/06/2001	(Earliest) Priority Date (day/month/year) 06/06/2000
Applicant TROJAN TECHNOLOGIES INC.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.
☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).
- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing:
- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the title,

- ☒ the text is approved as submitted by the applicant.
- ☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

- ☒ the text is approved as submitted by the applicant.
- ☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No.

- ☒ as suggested by the applicant.
- ☐ because the applicant failed to suggest a figure.
- ☐ because this figure better characterizes the invention.
- 2
☐ None of the figures.

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NOTES TO FORM PCT/ISA/220 (continued)

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

- (i) the claim is unchanged;
- (ii) the claim is cancelled;
- (iii) the claim is new;
- (iv) the claim replaces one or more claims as filed;
- (v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international application is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 01/00816

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 C02F1/32 B01J19/12 B01F5/00 B01J19/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 C02F B01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data, PAJ, EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
A	US 6 015 229 A (D.CORMACK ET AL) 18 January 2000 (2000-01-18) cited in the application claims; figures	1-47
A	US 5 614 723 A (TH.OPPENLÄNDER ET AL) 25 March 1997 (1997-03-25) claims; figures	1, 50, 51
A	WO 00 26144 A (TROJAN TECHNOLOGIES) 11 May 2000 (2000-05-11) cited in the application claims; figures	1, 47
A	US 5 937 266 A (M.MASAHIRO) 10 August 1999 (1999-08-10) claims; figures	47
	-/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *G* document member of the same patent family

Date of the actual completion of the international search

29 April 2002

Date of mailing of the international search report

08/05/2002

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 01/00816

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 418 370 A (J.M.MAARSCHALKERWEERD) 23 May 1995 (1995-05-23) cited in the application claims; figures	1-47
A,P	WO 00 51943 A (TROJAN TECHNOLOGIES) 8 September 2000 (2000-09-08) cited in the application claims; figures	1-47

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/CA 01/00816

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US 5418370	A	23-05-1995	AT 162956 T AT 203492 T AU 6153194 A AU 9610098 A BR 9406347 A CA 2117040 A1 CA 2239925 A1 WO 9420208 A1 CN 1121320 A ,B CZ 9502264 A3 DE 69408441 D1 DE 69408441 T2 DE 69427834 D1 DE 69427834 T2 DK 687201 T3 EP 1094035 A2 EP 0687201 A1 EP 0811579 A2 ES 2115937 T3 ES 2163695 T3 FI 954134 A HU 76196 A2 IL 108709 A IL 121307 A IL 121308 A IL 121309 A JP 8509905 T NO 953451 A NZ 262088 A NZ 328583 A PL 310528 A1 PL 177739 B1 PL 177744 B1 RO 114754 B1 SK 109195 A3 US 5590390 A US 5539210 A ZA 9401096 A	15-02-1998 15-08-2001 26-09-1994 22-07-1999 13-02-1996 06-09-1994 06-09-1994 15-09-1994 24-04-1996 17-04-1996 12-03-1998 17-09-1998 30-08-2001 04-04-2002 23-09-1998 25-04-2001 20-12-1995 10-12-1997 01-07-1998 01-02-2002 04-09-1995 28-07-1997 04-01-1998 06-12-2000 20-06-1999 09-05-1999 22-10-1996 01-09-1995 19-12-1997 28-01-1999 27-12-1995 31-01-2000 31-01-2000 30-07-1999 03-04-1996 31-12-1996 23-07-1996 16-09-1994

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			WO 0051943 A1	08-09-2000
			EP 1159225 A1	05-12-2001

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